MPA material matters

September 2006

Newsletter of the Materials Physics and Applications Division

Leading the pack

By Karen E. Kippen

Being the first out of the gate has its advantages, as long as you maintain your pace.

As one of the first of a new generation of scientists researching and developing fuel cell technology, Bryan Pivovar, fuel cell team leader in the Materials Physics and Application's Electrochemical and Sensors Group (MPA-11), has steadily stayed ahead of the pack.

Pivovar began studying fuel cells on a fellowship his first year of graduate school—a move he said gave him a head start. "I got my PhD in fuel cells before everyone started turning them out," said Pivovar, who earned his doctorate in chemical engineering from the University of Minnesota-Twin Cities in 2000. His thesis focused on electro-osmosis and electrochemical selectivity in direct methanol fuel cell electrolytes.

As fuel cells were not his advisor's primary interest, Pivovar charted his own course through graduate school, in the process becoming a mentor to younger students in the field. Pivovar said his role as tutor and advisor may

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Above, Bryan Pivovar (right), Yu Seung Kim (left), and Melinda Hill (center) discuss novel polymer electrolyte testing in MPA-11. Advances made from this research have led to the highest reported direct methanol fuel cell performance under realistic operating conditions.

Pivovar (pictured at right) is fuel cell team leader in the Materials Physics and Application's Electrochemical and Sensors Group (MPA-11).

INSIDE this issue

New leadership brings new energy to MPA-10 and MPA-STC

Two MPA organizations now feature new leadership, both with strong pre-existing ties to the Laboratory. Michael Hundley is the new MPA-10 group leader, having served as acting group leader for the past year and as Deputy Group Leader of MST-10 for almost two years.

Ken Marken

Ken Marken is the new MPA-STC deputy center leader and has worked with Los Alamos staff on various projects before arriving here in August.

Michael Hundley

Hundley received his Ph.D. in condensed-matter physics at the University of California, Berkeley and joined the Laboratory in 1988 as a Director's funded post-doctoral researcher working with Joe Thompson investigating high temperature superconductivity.

Originally attracted to the Laboratory's diverse research opportunities and active post-doctoral program, Hundley soon discovered he liked life in northern New Mexico and the Laboratory's research environment. "One of the

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From Cathy's desk...

Materials Physics and Applications: leading the way

As summer comes to a close and the fiscal year ends, so does my final Director's Development Program (DDP) Class of 2005 developmental assignment.

Since MPA's inception on June 1, I have been the acting deputy division leader and acting chief of staff for Materials Physics and Applications.

This dual role, in addition to keeping my "day jobs" as project leader for Hydrogen Codes and Standards and for Biomass Analysis, has been exciting and enlightening. I've learned a great deal about the work that MPA does and I am very optimistic about our future.

MPA is, in many ways, uniquely positioned to lead the Laboratory in the growth of its science portfolio. We serve as the Lab's focal point for fundamental materials physics and material chemistry, including capabilities in material synthesis and fabrication, materials characterization and spectroscopy, materials extremes, and materials applications.

Our internationally-recognized centers and groups provide unique experimental capabilities—and the scientific talent and infrastructure—to facilitate understanding and control of materials properties. These capabilities play in all seven of the Laboratory's Grand Challenges, with a primary role in three of the five "science" challenges (materials fundamentals, superconductivity, and carbon-neutral fuel cycles) as well as important supporting roles in detection and prediction challenges.

We are at the forefront in the development and application of materials-based solutions, enabling the discovery of new science and the development of new technologies to solve our nation's critical energy and security challenges. Given all that, it's easy to be excited about the future.

I'd like to share my overall experience in the DDP. The program has been a great opportunity to "test the waters" of management and leadership and to actively participate in shaping the future of the Lab.

Over an 18-month period, my classmates and I have participated in assessments, workshops and classes, and have had discussions with Lab leadership on their personal management experiences and leadership philosophy.

This unprecedented access to resources and upper management is perhaps the most important aspect of DDP. We were given a unique opportunity to look upward, to look outward, and to look inward.

It's been hard work, and sometimes personally difficult, but I am grateful to those who have supported me in this effort: Ken Stroh (my DDP sponsor and supervisor of my first developmental assignment), Ross Lemons (my mentor), Amy Anderson (my coach), and John Sarrao (supervisor for this assignment).

—Cathy Padró, MPA Deputy Division Leader and Chief of Staff (acting)

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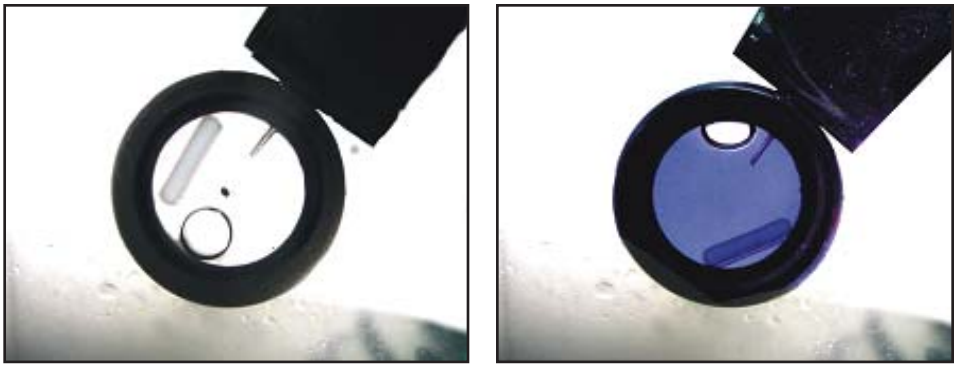
Celebrating service

MPA-MC researchers patent new materials based on ionic liquids

Ionic liquids represent a new set of solvents with immense promise for the development of new chemistry and new materials. The attributes of the ionic liquids can include temperature stability, a wide electrochemical window, conductivity, and unique solubilities. MPA-MC researchers Anthony Burrell, Benjamin Warner, Mark McCleskey have developed a method for synthesizing pure, water-clear, ionic liquids that enable their use in a variety of applications including electrochromic devices, sensors, a medium for water detection, and a platform for biological sensors.

Electrochromic windows, which use a current to reversibly reduce and oxidize a dye that goes from a clear state to a colored state, are a natural application for these highly conductive liquids. The researchers have patented several new materials based on ionic liquids for the application of electrochromic windows and the patent has been licensed from Los Alamos National Laboratory by Electrochomix Inc.



Colored and clear states of an ionic liquid electrochromic mirror.

Electrochromic windows are currently sold as high-end rearview mirrors that automatically darken. The ionic-liquid based devices have significantly increased stability over previous technology and could potentially be used as windows for buildings. Such windows could save the United States five percent in energy consumption by allowing in visible light on cold days and blocking it out on warm days.

Electrochromix has made prototype mirrors and plans to start production next year.

MPA-11's Sinha receives Distinguished Performance Small Team Award

Dipen Sinha, MPA-11, was part of Distinguished Performance Small Team Award for the Strategic Alliance for Advanced Energy Solutions between Los Alamos and Chevron Corporation.

Sinha, along with John Russell, Otis Peterson, and Robb Hermes, TT-D, and collaborator Jacobo Archuleta, ISR-4, partnered with Chevron Corporation to address critical energy security issues.

This partnership led to three significant successes: Swept-Frequency Acoustic Interferometry (SFAI), Trapped Annular Pressure (TAP), and Inficomm.

Sinha is project leader for SFAI, which applies acoustic spectroscopy to several important oil field problems, including diagnostics showing the proportion of oil, gas, sand, and water produced in a well and separation of this stream with noncontact methods and without the use of chemicals; and oil field diagnostics that help locate deposits that are increasingly difficult to find and extract.

The team used TAP to identify a solution for ruptured deep-sea well casings when super-heated oil and gas were extracted in near-freezing water. Each rupture cost approximately $100 million per lost well.

Inficomm technology, developed for defense customers to secure wireless battlefield communications, revolutionized the oil industry's ability to map real-time performance of an entire oil field, predict extraction efficiencies, and prioritize sites for new drilling.

The nature of these accomplishments demonstrates LANL's outstanding ability to resolve some of industry's toughest challenges through creative thinking and application of LANL's expertise across scientific disciplines.

Individuals or small teams who receive Distinguished Performance Awards must have made an outstanding and unique contribution that had a positive impact on the Laboratory's programmatic efforts or status in the scientific community, required unusual creativity or dedication of the individual or team and resulted from a level of performance substantially beyond what normally would be expected.

Spendelow joins MPA-11 as Director's Postdoctoral Fellow

Jacob Spendelow recently joined MPA-11 as a Director's Postdoctoral Fellow.

Spendelow, who grew up in Portland, Oregon, earned his bachelor's and master's degrees in chemical engineering from Case Western Reserve University and his doctorate in chemical and biomolecular engineering from the University of Illinois at Urbana-Champaign.

At Los Alamos he will perform electrocatalytic studies on non-noble metal catalysts for alkaline fuel cell applications.

Heads UP MPA!

Protecting government property

Several recent thefts of property reveal a need for more responsibility on the part of managers and some employees. Gates and fences to large areas do not provide much protection against theft of attractive items left laying around outside buildings or in unlocked buildings, offices, or other interior work areas. After hours buildings and interior rooms should be locked. Exterior receiving areas (docks) should be checked daily for smaller items that are easy stolen.

Escorting uncleared persons including foreign national

Uncleared U.S. citizens can only be escorted into security areas for official business, and all facility or technical area procedures must be followed, including proper badging, logging, announcements, and ensuring the uncleared visitor(s) does not gain access to anything classified.

Escorting uncleared foreign nationals

The following is taken from Annual Security Refresher Training which all employees are required to take."It is the escort's responsibility to ask the escortee of what country they are a citizen. If they say anything other than the U.S., different requirements must be followed. Please contact the Foreign Visits and Assignments Office for more information on escorting uncleared foreign nationals." Uncleared foreign nationals are authorized in some "open areas" without escort and in some designated Property Protection Areas without escort, but never in a security area without proper escort and unless special approval is first obtained.

If you have questions about escorting requirements for an area you are visiting please contact Darren Schnedler, 5-9853.

Foul weather driving tips

Incidents that are close calls in good weather can become collisions when rain, snow, and ice collects on roadways. The Smith System Defensive Driving Program offers tips towards preventing vehicular collisions.

The majority of all "weather-related" traffic collisions result from vehicle operators failing to properly adjust to conditions. The following, if incorporated in your driving routine, greatly reduces the probability of incurring a crash in foul weather.

The Smith System Defensive Driving Program emphasizes "aiming high" when processing information down the road. At a minimum, scan ahead at least 15 seconds in front of you at the rate of speed you're traveling. In good weather, this distance is a quarter mile; when travelling at 60 mph, however, if fog sets in or if rain, snow, and/or sleet is pelting your windshield, slow down. If you can, avoid travelling. If you're caught motoring in a blizzard just having a good defroster, intact windshield wipers, wiper fluid that doesn't freeze, along with clean mirrors has helped many a driver avoid serious hazards. Check the functionality of your running lights and clean head lamps on a regular basis to increase illumination capabilities. Scan your mirrors at a minimum every five to eight seconds to "get the big picture" and practice this axiom: toe to brake, eye to mirror.

At a minimum, try for at least a four-second space cushion between your vehicle and the vehicle traveling in front no matter what the road conditions are, but especially when roads are slick. Tailgating is a dangerous habit to practice in any situation. It robs the operator of precious time to react safely.

The proper and polite use of turn signals, lights, horns and, in some cases, eye contact and vocalization can make a difference. Ensure others see you and are aware of your intentions.

Provided your speed and following distance is proper, limit hard braking, accelerating, or sudden turns on black ice or slick roads. Utilize the engine/transmission to brake when possible (i.e. using lower gears on grade). Know what "black ice" it looks like and if you commute or travel regularly through the mountains, know where it builds up and slow down when driving over it. When the snows pile deep, having chains properly fitted for your vehicle's wheels is essential. If you have chains, be familiar with how they work.

LANL's White Rock Training Center offers Smith System Defensive Driving courses on a monthly basis. Information 7-0059.

Heads UP, MPA! reports on environment, safety, and health, security, and facility-related news and information.

"Leadership" *Continued from page 1*

best things here coming from graduate school is that people work together and collaborate," he said. He has been a technical staff member in MST-10/MPA-10 since 1991. Hundley's technical interests are in the area of electronic transport and thermodynamic properties of correlated electron systems, a field in which he has published more than 200 papers and given numerous invited talks.

His vision for MPA-10 includes building on the group's strengths in materials and thermal physics. New opportunities exist for research in correlated electron physics, superconductivity in actinides, thermoacoustics and non-linear fluid dynamics. "In the end, we have excellent people," Hundley said. "And the people are the key to our organizations." He lives in White Rock with his wife and two children.

The new MPA-STC Deputy Center Leader Ken Marken comes to Los Alamos from New Jersey where for 15 years he led the $3 million high temperature superconductor program at Oxford Instruments-Superconducting Technology.

Marken, who received his doctorate in materials science from the University of Wisconsin-Madison, has 25 years of experience in materials research and development with a focus on both low and high temperature superconductors.

In his new role Marken said he is looking forward to using his experience in project development to expand the Center's role in the application of superconductivity, particularly in partnership with the electric power industry. "Superconductivity is at a place where if we can get the materials into applications I think it will benefit the nation," he said.

Marken has previous ties to Los Alamos. He was principal investigator on the Oxford-LANL CRADA over the past 10 years, working with Terry Holesinger and Dean Peterson. The wealth of "information and expertise" available at the Laboratory makes it "an exciting place to be," he said. And "it's a great group of people in the STC, who have great reputations and have done a lot of great work."

He resides in Los Alamos with his wife and daughter.

MPA had significant presence at international magnetism conference

Five MPA-10 and three NHMFL researchers presented their work at the International Conference on Magnetism held recently in Kyoto, Japan.

From MPA-10 Joe Thompson presented a plenary talk on the magnetism and unconventional superconductivity exhibited by isostructural cerium and plutonium "115" compounds. Eric Bauer discussed his research on magnetism and crystalline electric fields in cubic ternary uranium zinc compounds, and Filip Ronning presented his thermodynamic and electronic transport study on magnetic excitations in the two-dimensional spin layer present in Sm(La,Sr)CuO_4. Yoshi Tokiwa presented his low-temperature magnetization and specific-heat study of $YbIn_{1-x}Rh_xCu_4$ and discussed the relationship between ferromagnetic correlations and non-Fermi liquid behavior around the critical concentration x = 0.6.

Evgueni Nazaretski presented magnetic resonance force microscopy studies in thin permalloy films that was carried out in a collaboration involving researchers in MPA-10, Ohio State University, the University of Alabama, and the Naval Research Laboratory.

At the conference from NHMFL, Neil Harrison discussed itinerant hidden order and quasiparticles in URu_2Si_2. Peter Sharma discussed magnetic-field dependent elasticity at the "strain glass" transition in $La_{5/8-x}Pr_xCa_{3/8}MnO_3$" and Marcelo Jaime presented work on non-local magnetic field-tuned quantum criticality in cubic $CeIn_{3-x}Sn_x$(x=0.25).

Innovative Detection Materials and Concepts Program Review features MPA-MC work on novel composites for radiation detectors

A program review of the Department of Homeland Security's Domestic Nuclear Detection Office (DNDO) funded efforts at LANL in the area of innovative detection materials and concepts was held last month at the Laboratory.

Researchers in MPA-MC prepare novel composites for radiation detectors in support of this program. MPA-MC's specific contribution is in the area of synthesis and characterization of monodisperse nanophosphor materials. In addition to descriptions of technical progress, tours were held to showcase Laboratory capabilities. This included a tour of MPA-MC's nanoparticle synthesis and scale-up capability at TA-48. Rico Del Sesto, a postdoctoral researcher in MPA-MC, has made significant contributions to this program through his synthesis of near-monodisperse nanocrystals in the range of 5 to 10 nm of doped lanthanide halides having suitable spectroscopic and optical properties for incorporation into plastic composite detector elements. This work is a collaboration with colleagues in N-1, MST-8 (Wayne Cooke, Ross Muenchausen) and MST-7 (Robert Gilbertson). N-1's Ed McKigney is project leader for the overall effort.

Pulsed Field Facility achieves world record magnetic field in 100-tesla quest

Scientists at the National High Magnetic Field Laboratory's Pulsed Field Facility at Los Alamos National Laboratory have set a world record for nondestructive pulsed-magnet performance that puts them in position to deliver a magnet capable of achieving 100 tesla, the longstanding goal of magnet designers and researchers around the globe.

A 100-tesla magnet could have a profound impact on a wide range of scientific investigations, from studies of how materials behave under the influence of very high magnetic fields to research into the microscopic behavior of phase transitions.

In August, Pulsed Field Facility staff completed commissioning of an outer set of coils for a massive magnet being designed and assembled at Los Alamos. During the commissioning, the coil produced a peak magnetic field intensity of 35 tesla within the coil's 225 millimeter-diameter bore. This achievement is significant because of the record large volume in which the 35-tesla field was produced, and because man-made fields of this strength have never before been produced without the use of highly destructive, explosives-driven, field-generating technologies.

The study of materials behavior at the extreme conditions of temperature, pressure, and magnetic fields is a vital component of Los Alamos research aimed at understanding of the physics of structurally complex systems at a quantum level.

These recent successes were enabled by long-term support from the U.S. Department of Energy's Office of Basic Energy Sciences and the National Science Foundation's 100 Tesla Multi-Shot magnet program.

Got news?

MPA Material Matters features technical highlights developed each week for the Director's Office.

If you have unclassified news you'd like to see featured, please send it to your group leader to be forwarded to *MPA Material Matters* Editor Karen Kippen.

"Pivovar" *Continued from page 1*

have "slowed me down a bit, but it was also a valuable experience. I think it's helped me (at the Laboratory). It's certainly not hurt my career."

Leadership at LANL

The Wisconsin native arrived at Los Alamos National Laboratory in 2000 as a postdoctoral researcher. Excited to be a part of the Laboratory where in 1977 the first fuel cells for transportation program was started, Pivovar was drawn to the Laboratory by seminal work and key breakthroughs achieved here by the fuel cell team, "particularly the work of Mahlon (Wilson), Tom (Springer), Shimshon (Gottesfeld) and Tom (Zawodzinski)," he said.

Pivovar was drawn to the Laboratory's "unique research environment" where "somebody can make the most impact on technology from a research level." He became a technical staff member in 2001.

Pivovar's leadership skills quickly caught the attention of MPA-11 Group Leader Ken Stroh, who made the young scientist a team leader in 2005. "He's just a natural mentor," Stroh said. "You walk by his office and there's always a student or staff member in there discussing some technical aspect of the work." Described by Stroh as "a consensus builder," Pivovar was a member of the first class of MST Division's Leadership Development Initiative and will next year chair the Gordon Research Conference on fuel cells.

Playing a leadership role and speaking for his MPA-11 team in the fuel cell community, Pivovar said, "is an easy thing to do, given the quality of our team. To go out and represent them is an honor."

Pivovar's favorite experiment
What: Probing membrane-electrode interfacial resistance
When: 2003
Where: LANL.
How: By varying membrane thickness and preparing identical membrane electrode assemblies we were able to decouple the effect of the membrane-electrode interface from performance parameters and explain why most novel polymer electrolytes didn't give better fuel cell performance even though they had improved properties from a membrane standpoint.
A-ha moment: When we graphed cell resistance changes versus time, we found a clear correlation showing swelling differences between the membrane and the electrodes led to decreased performance and lifetimes. From these results we collaborated with polymer chemists to modify water uptake while maintaining other desirable properties, leading to increased fuel cell performance and better durability.

Growth of fuel cell science

Fuel cells "are the kind of technology that is really easy to get behind," Pivovar said, a technology with the potential to be a more efficient energy source, create a cleaner planet, "and be a benefit for all mankind."

A new and emerging field when he was in graduate school, fuel cells have emerged as a hot topic in the years since. Unlike a few years ago when "conferences were attended by 50 people and you knew all of them," he said, today "there are 1,000 new faces and you know only a small fraction."

As a positive result "the science does move forward at a faster pace. There are fresh ideas and new perspectives brought into it," Pivovar said. "In recent years the advance of science has been fairly impressive. There are things we probably didn't understand a few years ago that we have a better understanding of now."

And it's scientific endeavors—rather than engineering ones—that intrigue Pivovar most, which has him seeking the next challenge.

"Bryan strives to do things beyond just getting the technical job done," Stroh said. "He is one of those people who wants to make a difference."

Energy issues remain at the core of his interests. "Energy will be perhaps the biggest global concern for the next 20 to 50 years," Pivovar said, adding that fuel cells can play a role in the solution, particularly in terms of transportation. But confronting and surmounting these challenges will involve societal change, "and I'd like to play a role in making the right decisions," whether that be in a position at the Laboratory or elsewhere.

He's thankful that despite the group's past funding issues, the Laboratory transition, and the uncertainty that comes with now having to compete in an open solicitation for DOE fuel cell research funds, "people's moods (in MPA-11) are fairly high," he said, citing high energy, enthusiasm, and harmony. He attributed this, in part, to the fact that "people still recognize…that there is no other place within the fuel cell community where you can do the things this place does."

Pivovar lives in Los Alamos with his wife Laura and one-year-old daughter Ava.

Lab partners with CNT Technologies to commercialize SuperThread™ carbon-nanotube fiber

Los Alamos National Laboratory has licensed its carbon nanotube technology to a new commercial partner, Seattle-based CNT Technologies Inc. (CNT Tech). The ultrastrong, lightweight carbon-nanotube fiber, branded SuperThread™ by the company, can have better properties than steel for many applications.

"Our advancement of carbon nanotube technology can lead to a broad range of applications including airplanes, bullet-proof vests, electronic devices, and artificial limbs," said MPA-STC Center Leader Dean Peterson. Laboratory scientists, including MPA-STC's Yuntian Zhu, are developing arrays of ultralong, super-strong, lightweight, double-walled carbon nanotubes that may be spun into fibers that could prove to be some of the strongest materials on earth.

Within six months CNT Tech plans to be making one kilogram per day of SuperThread yarn. Over the next 15 months, CNT Tech plans to scale up production of the nanotubes in its new laboratory at Los Alamos Research Park. It will begin spinning the fiber on a custom-designed, computer-controlled spinning machine. *— By Hildi T. Kelsey*